

**ANNEX  
BETWEEN  
THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
AMES RESEARCH CENTER  
AND  
REGENTS OF THE UNIVERSITY OF MINNESOTA  
UNDER SPACE ACT UMBRELLA AGREEMENT NO. 34514, SAA2-403617  
(ANNEX NUMBER ONE)**

**ARTICLE 1. PURPOSE**

This Annex One under the Reimbursable Space Act Umbrella Agreement SAA2-403617 (the “Umbrella Agreement”) between University of Minnesota (“UMN” or “Partner”) and NASA Ames Research Center (“NASA” or “NASA ARC”) shall be for the purpose development of hypersonic flight systems. The Hypersonic Configurable Unit Ballistic Experiment (HyCUBE) project at the University of Minnesota seeks to develop a sensor pod and experimental techniques for making hypersonic measurements in real flight conditions. The primary goal of this Annex is to build and test a datalink for HyCUBE flight tests.

The Entry Systems and Technology team at NASA ARC operates unique facilities and has expertise measuring performance of Thermal Protection Systems (TPS) in hypersonic flows for both ground test and flight, including expertise in Small Satellite technology and Hypersonic flight systems like the TechEdSat series of CubeSat missions.

Under this Annex agreement, two TechEdSat missions will be performed and the proposed work will be accomplished in two phases. Phase 1 will focus on a flight test of Iridium SDB-9603 modem on TES-n (TES-13) to characterize communication performance. Phase 2 will have a flight test of TES with an integrated Iridium SDB-9523, and upgraded antenna to demonstrate sensor data relay capabilities for future hypersonic flight tests. The newer sensor will be incorporated into the Entry, Descent and Landing (EDL) module which will record dynamic state data of the vehicle as it re-enters. In each phase, both NASA and UMN will jointly develop the Engineering Development Units (EDU). NASA will fabricate the flight units and subsequently execute the flight test(s). NASA will acquire all materials to conduct its work under this Annex. Accordingly, any hardware produced will be considered NASA personal property to remain in its custody throughout the agreement.

In addition, availability permitting, NASA ARC will provide mentorship to UMN researchers and students related to the activities conducted under this Annex.

The legal authority for this Annex, consistent with the Umbrella Agreement, is in accordance with the National Aeronautics and Space Act (51 U.S.C. § 20113(e)).

**ARTICLE 2. RESPONSIBILITIES**

A. NASA ARC will use reasonable efforts to:

Phase 1: Iridium SBD-9603

1. Provide information about interfaces of the SBD-9603 system to the UMN team for radio modem development;
2. Build and fabricate the EDU in parallel with the communication systems (per the rigors of the process; solder/cleanliness certificates; flight wire/connectors, etc...);
3. Develop and define the hardware and software interfaces of the SBD-9603 communication experiment to the avionics flight hardware stack;
4. Provide documentation of the design and testing, including appropriate requirements, to enable fabrication and flight tests to be conducted in accordance with NASA policy and requirements;
5. Fabricate the flight unit and conduct any required testing of the flight unit prior to launch;

Phase 2: Iridium-9523

6. Provide information about interfaces of the Iridium-9523 system to the UMN team for radio modem development;
7. Build and fabricate the 9523 interface circuit board, mechanical attachment hardware in preparation for the flight unit, power/electrical system specification, interface related software;
8. Integrate antenna with the Iridium-9523 modem and the Iridium-9523 modem into the EDL module within Flight Unit;
9. Fabricate the flight unit and conduct any required testing of the flight unit prior to launch;

General

10. Acquire the necessary materials to conduct its efforts under this Annex; all materials acquired will remain NASA property and flight units are expected to be consumed upon re-entry;
11. Arrange, at Partner's expense, for the launch of the TechEdSat nanosatellites into operational orbit:
  - a. Prepare the National Telecommunications and Information Authorization (NTIA) paperwork to use the radio spectrum from orbit; and

- b. Prepare the Orbital Debris Assessment Report (ODAR) to show that a deployed vehicle will not be a debris hazard as it re-enters
- 12. Conduct the activities under this Annex, (e.g. design, fabrication, launch, testing and operation) in accordance with NASA policy and requirements (e.g. NASA Procedural Requirement (NPR) 7120.8);
- 13. Conduct evaluations of the flight units and the on-orbit operations of the experiments and provide findings to UMN; and
- 14. As availability permits and in accordance with U.S. laws and regulations, including any constraints such as the Export Administration Regulations (EAR), provide mentorship to UMN researchers and students on the subjects relevant to the purposes of this Annex that will include bi-weekly meetings whereby the UMN staff/students follow the progression of the EDU and flight unit development.

B. Partner will use reasonable efforts to:

- 1. Develop at its expense the radio modems that will be used on both TechEdSat flights according to the specifications;
- 2. Develop and test the software interfaces for the modems according to the specifications, (e.g. a tailored NPR 7120.8 specifications);
- 3. Be responsible for understanding and implementing requirements provided by NASA to ensure that the activities under this Annex (e.g. design, fabrication, launch, testing and operation) can be conducted in accordance with NASA policy and requirements (e.g. a tailored NPR 7120.8 specifications);
- 4. Provide any necessary and relevant information to enable the launch arrangements, required reports or regulatory information; and
- 5. Conduct the post-process the flight test data during and after the completion of the flights operations and provide data/conclusions/test information to NASA.

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### ARTICLE 3. SCHEDULE AND MILESTONES

The planned major milestones for the activities for this Annex defined in the "Responsibilities" Article are as follows:

<b>Milestone</b>	<b>Estimated Completion Date</b>
Provide information about interfaces of the radio modem system including the documentation on fabrication and flight tests and develop a communication system around the Iridium SBD-9603 (NASA)	Execution of Annex One + no later than 3 months
Develop the radio modems that will be used on both TechEdSat flights and implement NASA provided requirements for fabrication and flight tests (UMN)	Execution of Annex One + no later than 6 months
Fabricate and test the flight units (NASA)	Execution of Annex One + no later than 8 months
Develop a communication system around the Iridium-9523 and integrate antenna with the Iridium SBD-9523 modem and then integrate the subject modem into the TechEdSat system and software architecture (NASA)	Execution of Annex One + no later than 15 months
Develop and test the software interfaces for the modems (UMN)	Execution of Annex One + no later than 18 months
Mentor UMN researchers and students (NASA)	Execution of Annex One + no later than 21 months
Prepare the National Telecommunications and Information Authorization (NTIA) paperwork to use the radio spectrum from orbit under both the phases as well as the Orbital Debris Assessment Report (ODAR) under both the phases to show that a deployed vehicle will not be a debris hazard as it re-enters (NASA)	Execution of Annex One + no later than 21 months
Launch the TechEdSat nano satellites into operational orbit (NASA)	Execution of Annex One + no later than 21 months
Post-process the flight test data during and after the completion of the flights (UMN)	Execution of Annex One + no later than 22 months
Evaluate the actual flight units as well as on orbit operation of the experiment (Joint)	Execution of Annex One + no later than 24 months

### ARTICLE 4. FINANCIAL OBLIGATIONS

A. Partner agrees to reimburse NASA an estimated cost of \$150,000 for NASA to carry out its responsibilities under this Annex. Each payment shall be marked with "Ames Research Center, SAA2-403617-1."

B. NASA will not provide services or incur costs beyond the current funding. Although NASA has made a good faith effort to accurately estimate its costs, it is understood that NASA provides no assurance that the proposed effort under this Annex will be accomplished for the estimated amount. Should the effort cost more than the estimate, Partner will be advised by NASA as soon as possible. Partner shall pay all costs incurred and have the option of canceling the remaining effort, or providing additional funding in order to continue the proposed effort under the revised estimate. Should this Annex be terminated, or the effort completed at a cost less than the agreed-to estimated cost, NASA shall account for any unspent funds within one year after completion of all effort under this Annex, and promptly thereafter, at Partner's option return any unspent funds to Partner or apply any such unspent funds to other activities under the Umbrella Agreement. Return of unspent funds will be processed via Electronic Funds Transfer (EFT) in accordance with 31 C.F.R. Part 208 and, upon request by NASA, Partner agrees to complete the Automated Clearing House (ACH) Vendor/Miscellaneous Payment Enrollment Form (SF 3881).

#### ARTICLE 5. INTELLECTUAL PROPERTY RIGHTS - DATA RIGHTS

A. Data produced under this Annex which is subject to paragraph C. of the Intellectual Property Rights - Data Rights Article of the Umbrella Agreement will be protected for the period of two years.

B. Under paragraph H. of the Intellectual Property Rights - Data Rights Article of the Umbrella Agreement, Disclosing Party provides the following Data to Receiving Party. The lists below may not be comprehensive, are subject to change, and do not supersede any restrictive notice on the Data provided.

1. Background Data:

The Disclosing Party's Background Data, if any, will be identified in a separate document.

2. Third Party Proprietary Data:

The Disclosing Party's Third Party Proprietary Data, if any, will be identified in a separate document.

3. Controlled Government Data:

The Disclosing Party's Controlled Government Data, if any, will be identified in a separate document.

4. The following software and related Data will be provided to Partner under a separate Software Usage Agreement:

None.

#### ARTICLE 6. TERM OF ANNEX

This Annex becomes effective upon the date of the last signature below ("Effective Date") and shall remain in effect until the completion of all obligations of both Parties hereto, or two years from the Effective Date, whichever comes first, unless such term exceeds the duration of the Umbrella Agreement. The term of this Annex shall not

exceed the term of the Umbrella Agreement. The Annex automatically expires upon the expiration of the Umbrella Agreement.

#### ARTICLE 7. RIGHT TO TERMINATE

Either Party may unilaterally terminate this Annex by providing thirty (30) calendar days written notice to the other Party.

#### ARTICLE 8. POINTS OF CONTACT

The following personnel are designated as the Points of Contact between the Parties in the performance of this Annex.

##### Management Points of Contact

NASA Ames Research Center  
Brenden Sanborn  
Agreement Manager  
Mail Stop: 223-3, Room 100  
Moffett Field, CA 94035  
Phone: (650) 604-6662  
brenden.sanborn@nasa.gov

Regents of the University of Minnesota  
Name: Josh Gates  
Title: Sr. Grant and Contract Officer  
Email: gates191@umn.edu

##### Technical Points of Contact

NASA Ames Research Center  
Alan Cassell  
Deputy Division Chief  
Mail Stop: 229-1  
Moffett Field, CA 94035  
Phone: 650.604.2325  
alan.m.cassell@nasa.gov

Regents of the University of Minnesota  
Demoz Gebre Egziabher  
PhD  
231 Pillsbury Drive S.E.  
Minneapolis, MN 55455-0213  
Email: gebre@umn.edu

Authorized Official:  
Nic Allyn  
Principal Grant and Contract Officer  
612-626-2265  
ally0007@umn.edu

#### ARTICLE 9. MODIFICATIONS

Any modification to this Annex shall be executed, in writing, and signed by an authorized representative of NASA and the Partner. Modification of an Annex does not modify the terms of the Umbrella Agreement.

## ARTICLE 10. SIGNATORY AUTHORITY

The signatories to this Annex covenant and warrant that they have authority to execute this Annex. By signing below, the undersigned agrees to the above terms and conditions.

**NATIONAL AERONAUTICS AND  
SPACE ADMINISTRATION  
AMES RESEARCH CENTER**

**Regents of the UNIVERSITY OF  
MINNESOTA**

BY: GREGORY JOSSELYN Digitally signed by GREGORY  
JOSSELYN  
Date: 2022.07.12 10:35:55 -07'00'  
Gregory Josselyn  
Director of Engineering (Acting)

BY: See next page  
Name: \_\_\_\_\_  
Title: \_\_\_\_\_

DATE: July 12, 2022

DATE: \_\_\_\_\_

ARTICLE 10. SIGNATORY AUTHORITY

The signatories to this Annex covenant and warrant that they have authority to execute this Annex. By signing below, the undersigned agrees to the above terms and conditions.

**NATIONAL AERONAUTICS AND  
SPACE ADMINISTRATION  
AMES RESEARCH CENTER**

**REGENTS OF THE  
UNIVERSITY OF  
MINNESOTA**

BY: See previous page  
Dr. Rupak Biswas  
Director of Exploration Technology  
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BY:   
Name: Nicolas Allyn  
Title: Principal Grants and Contracts Officer

DATE: \_\_\_\_\_

DATE: 6/24/2022